

# **Future projections of the Greenland ice sheet climate simulated by the regional climate model MAR forced by 2 CMIP5 global models.**

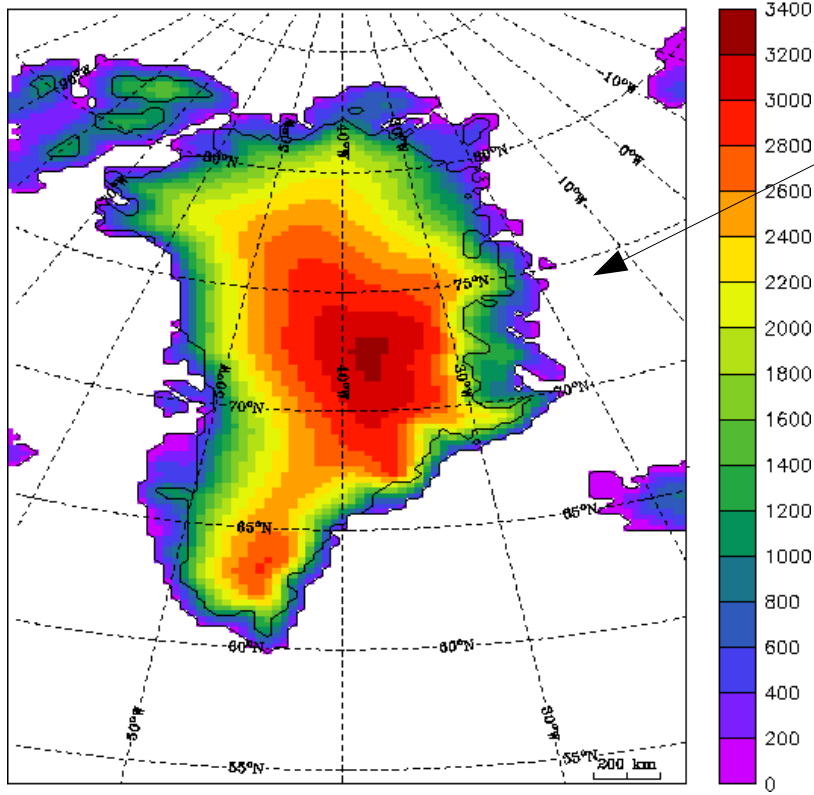
**(WP 4.2)**

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University of Liège (Belgium)

# Regional Climate MAR model



Compared to the ICE2SEA MAR simulations, a new ice sheet mask is used here and the Bamber et al. (2001) topography is less smoothed.



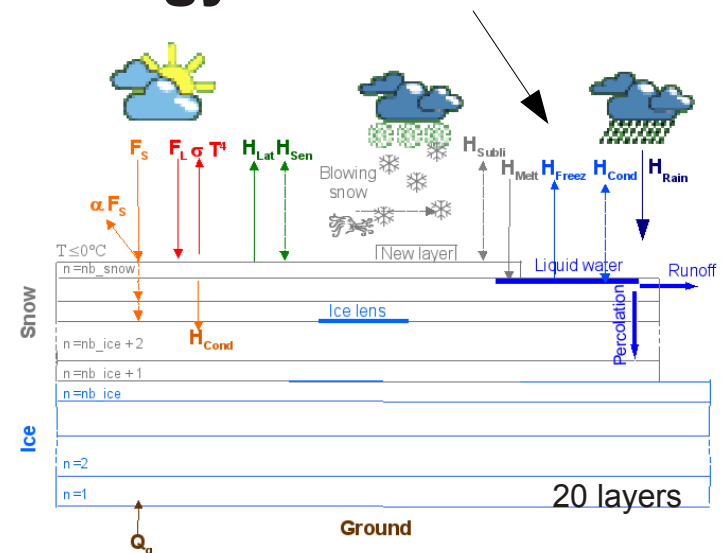
Topography at 25km

## Regional climate model MAR

1<sup>st</sup> level: 3m, 25<sup>th</sup> level ~ 21km

Resolution: 25km

full coupled with a snow energy balance model

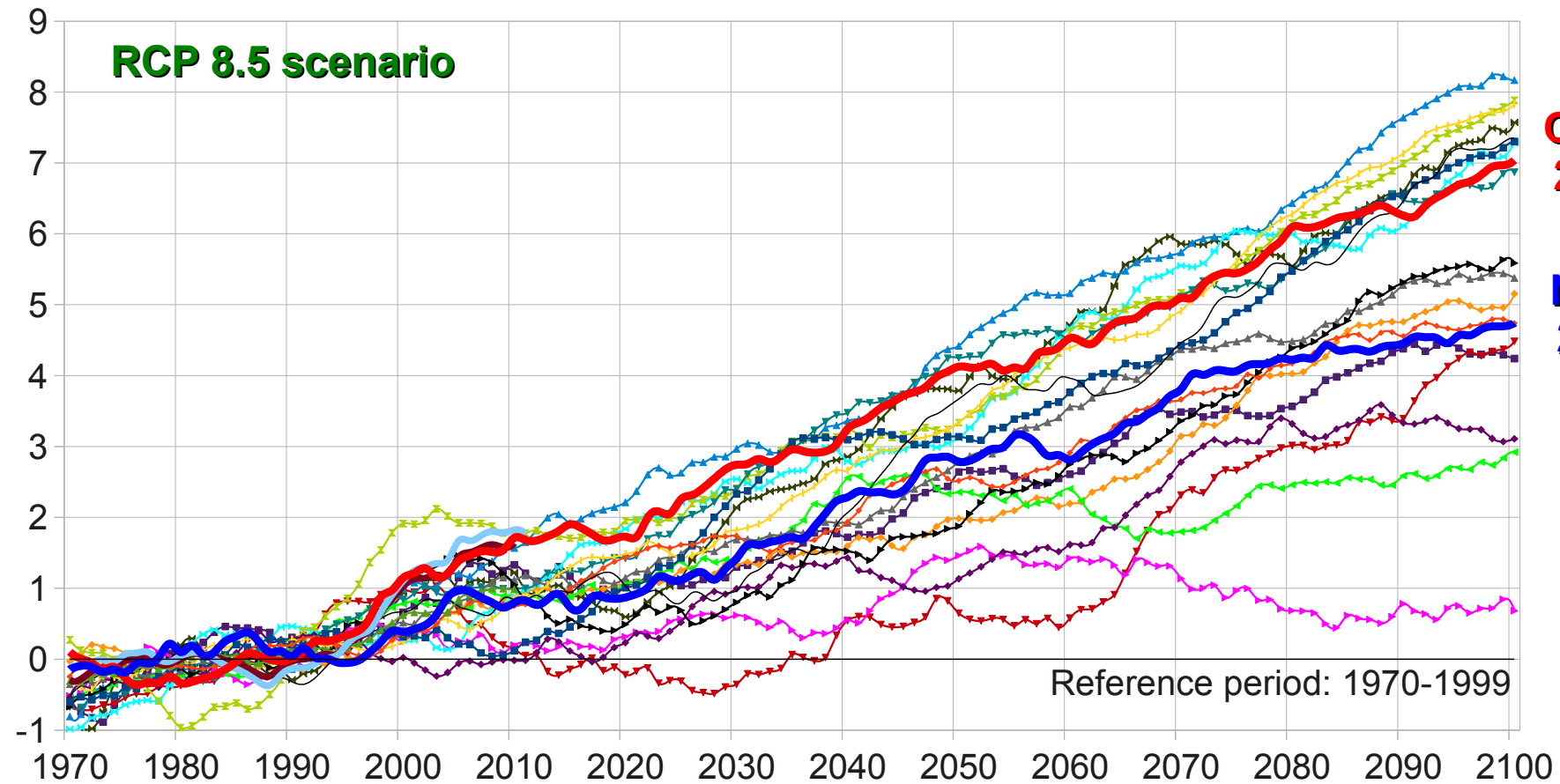




# Global models from CMIP5



Annual Greenland temperature anomaly (°C)

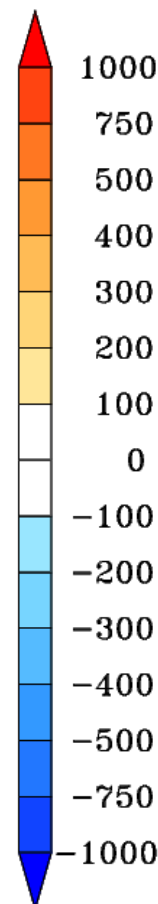
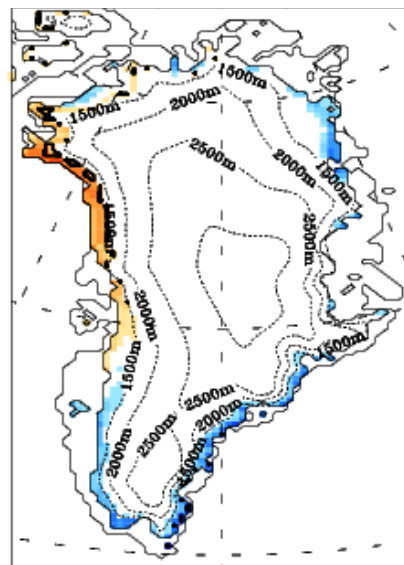
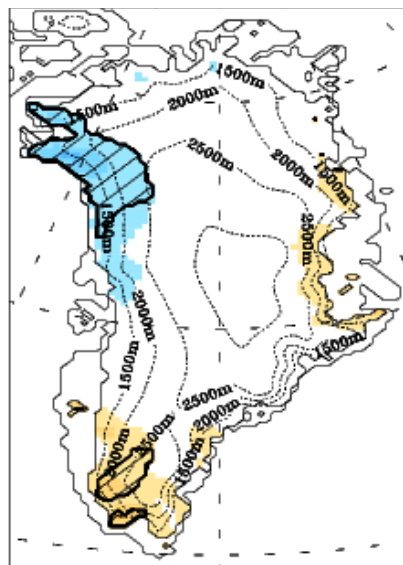
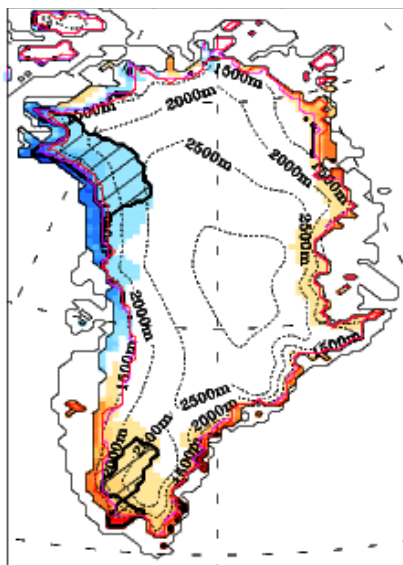


- |                |                      |                  |                   |
|----------------|----------------------|------------------|-------------------|
| —◆— BCC-CSM1   | —■— CCSM4            | —◆— CMRM-CM5     | —▼— CSIRO-Mk3-6-0 |
| —▲— GFDL-CM3   | —◆— GFDL-ESM2G       | —▲— GISS-E2-R    | —◆— HadGEM2-CC    |
| —◆— HadGEM2-ES | —◆— INMCM4           | —▼— IPSL-CM5A-LR | —▲— IPSL-CM5A-MR  |
| —▲— MIROC5     | —◆— MIROC-ESM-CHEM   | —■— MIROC-ESM    | —◆— MPI-ESM-LR    |
| —■— MRI-CGCM3  | —▲— 20th Cent. Rean. | —■— ERA-INTERIM  | —■— NCEP          |
| —■— CanESM2    | —■— NorESM1-M        |                  |                   |

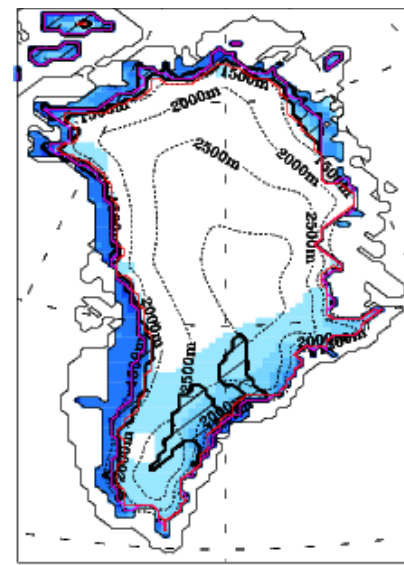
➡ See my poster for more details

# 1. Current climate (1/1)

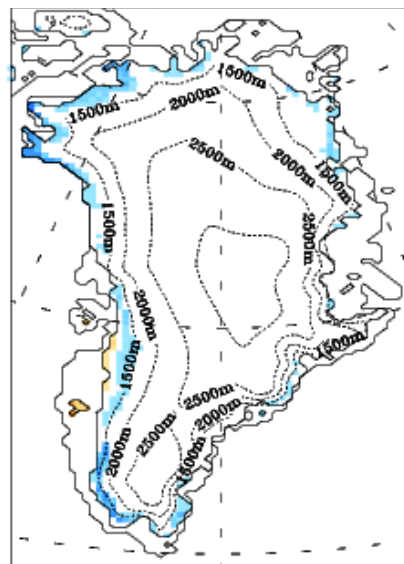
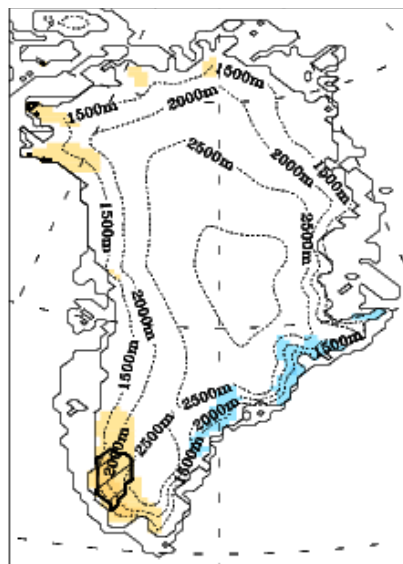
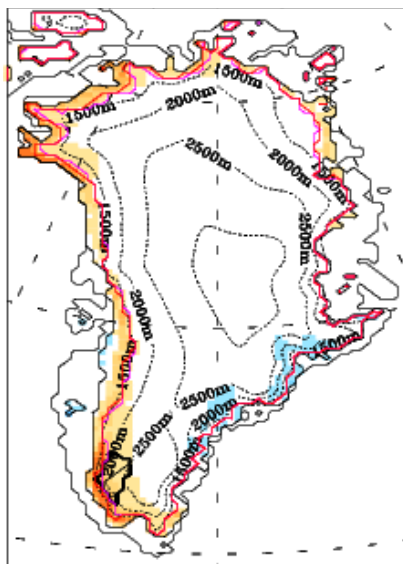
MAR forced by CanESM2



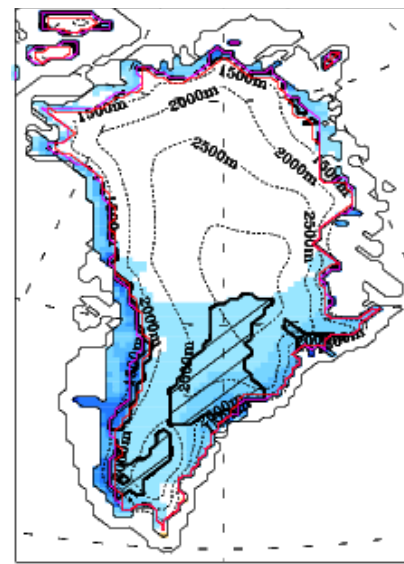
MAR forced by HadCM3



MAR forced by NorESM1



MAR forced by ECHAM5



SMB (mmWE/yr)

Snowfall (mmWE/yr)

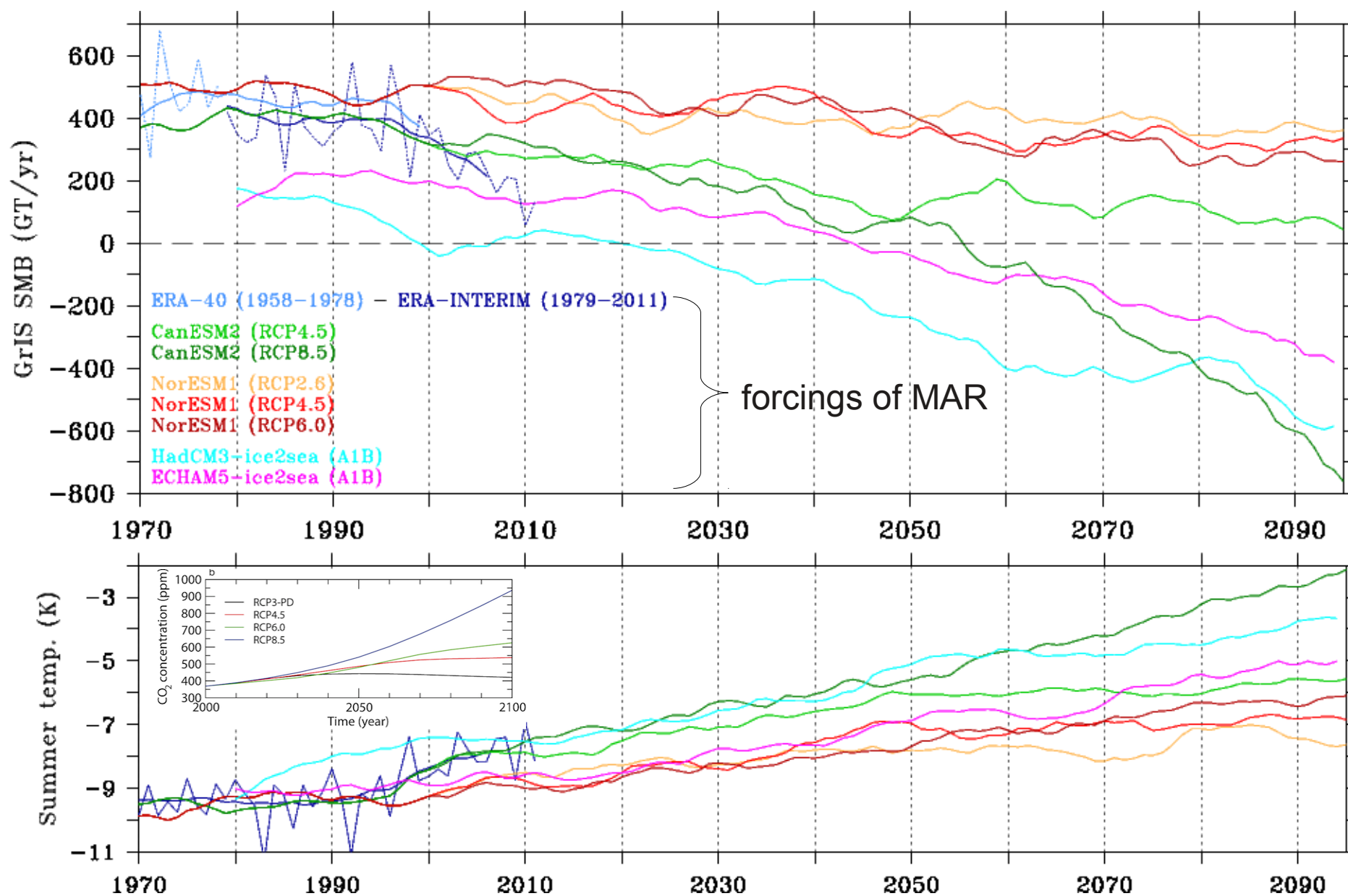
Run-off (mmWE/yr)

SMB (mmWE/yr)

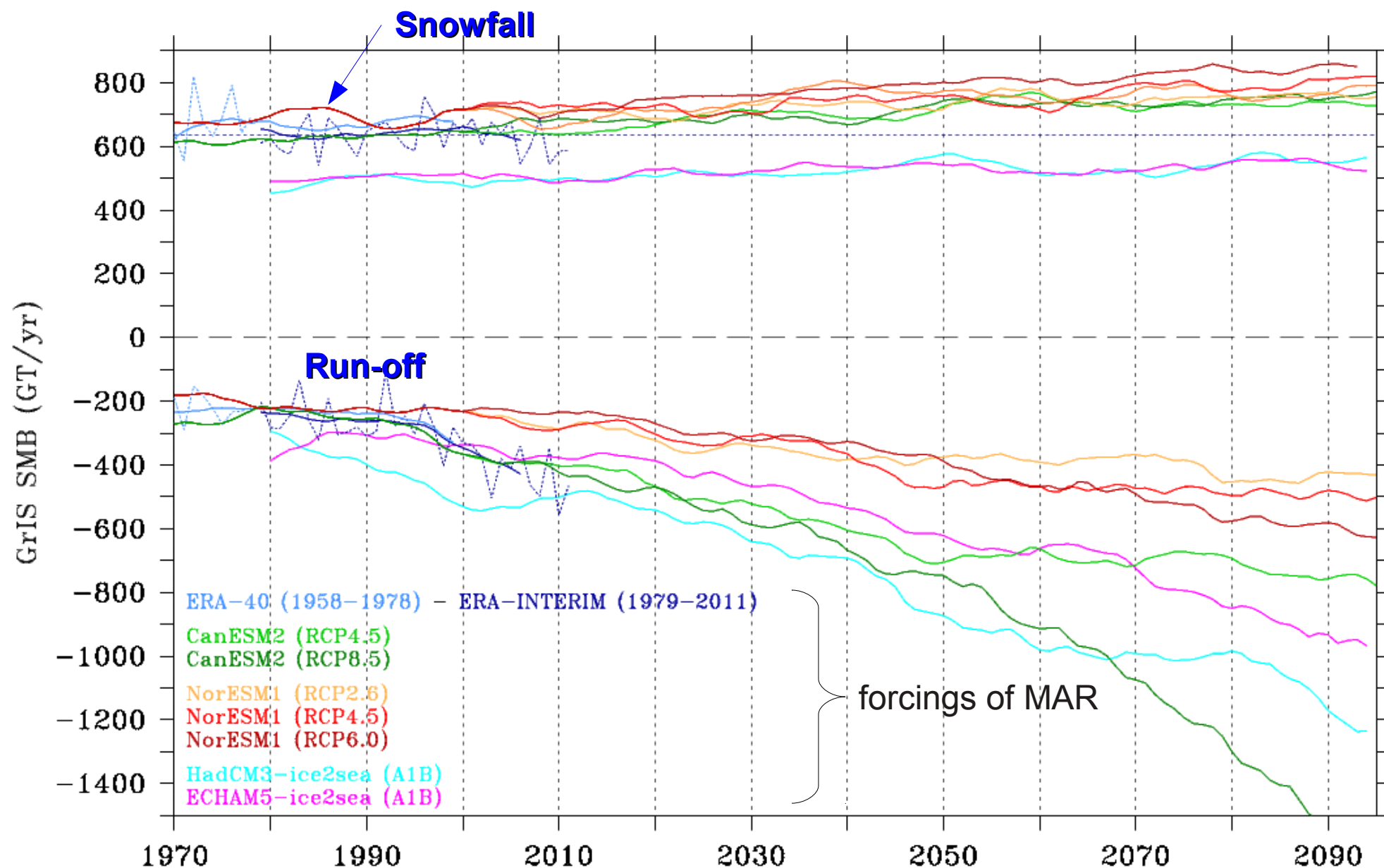
Anomalies in respect to MAR forced by ERA-INTERIM over 1980-1999



## 2. MAR based future climate (1/5)

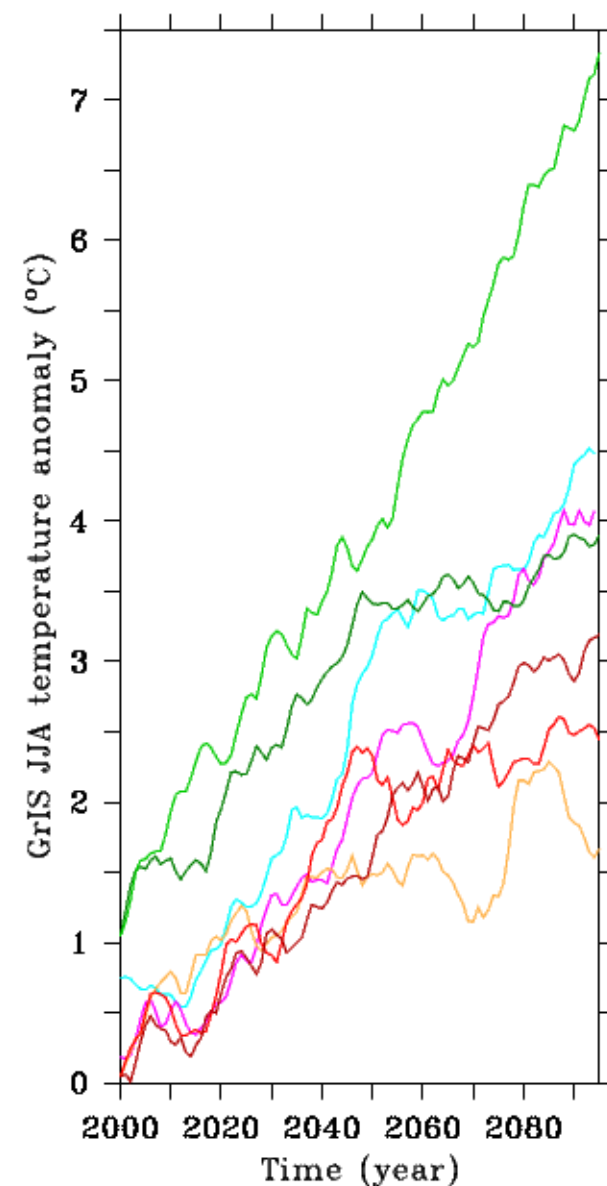
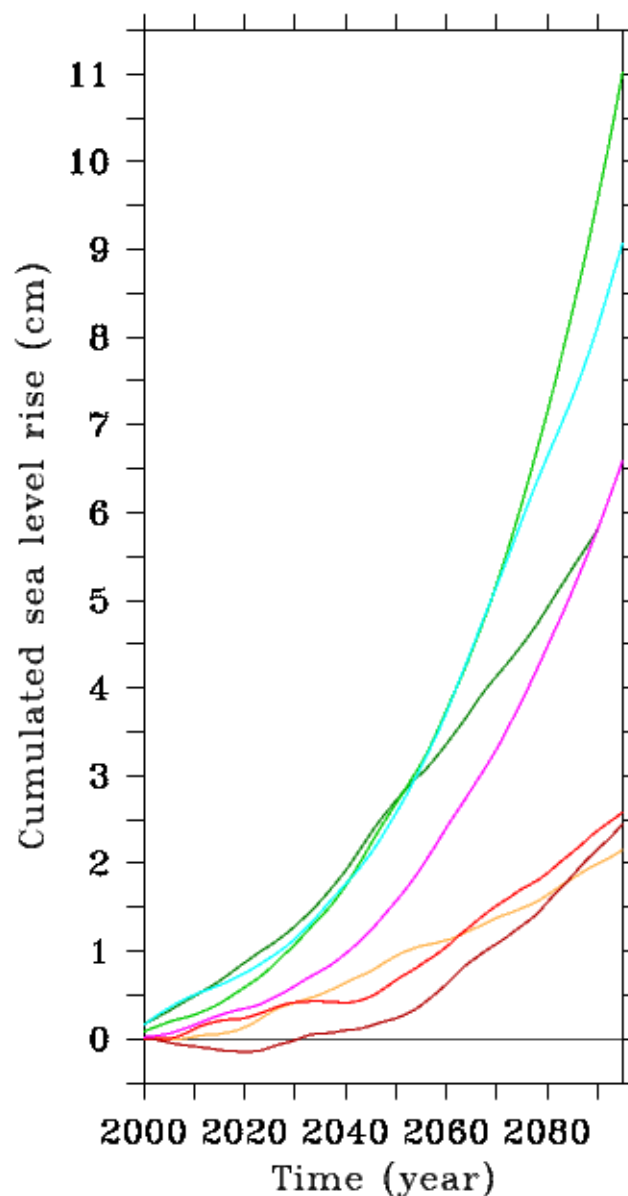
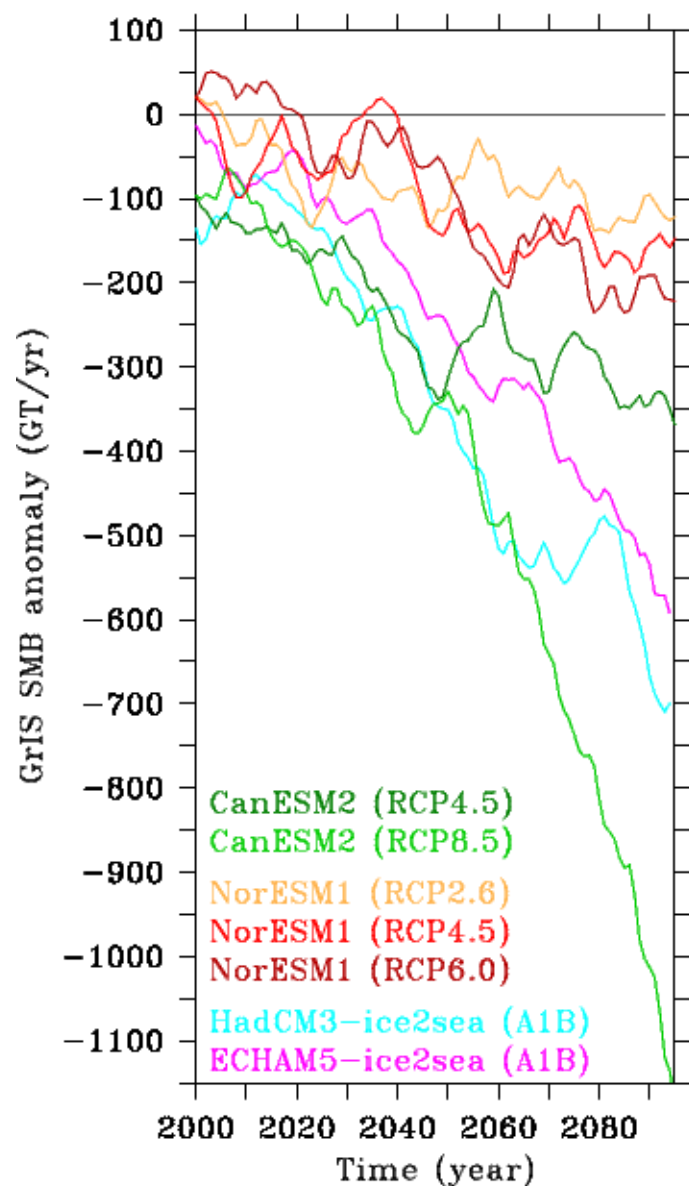


## 2. MAR based future climate (2/5)



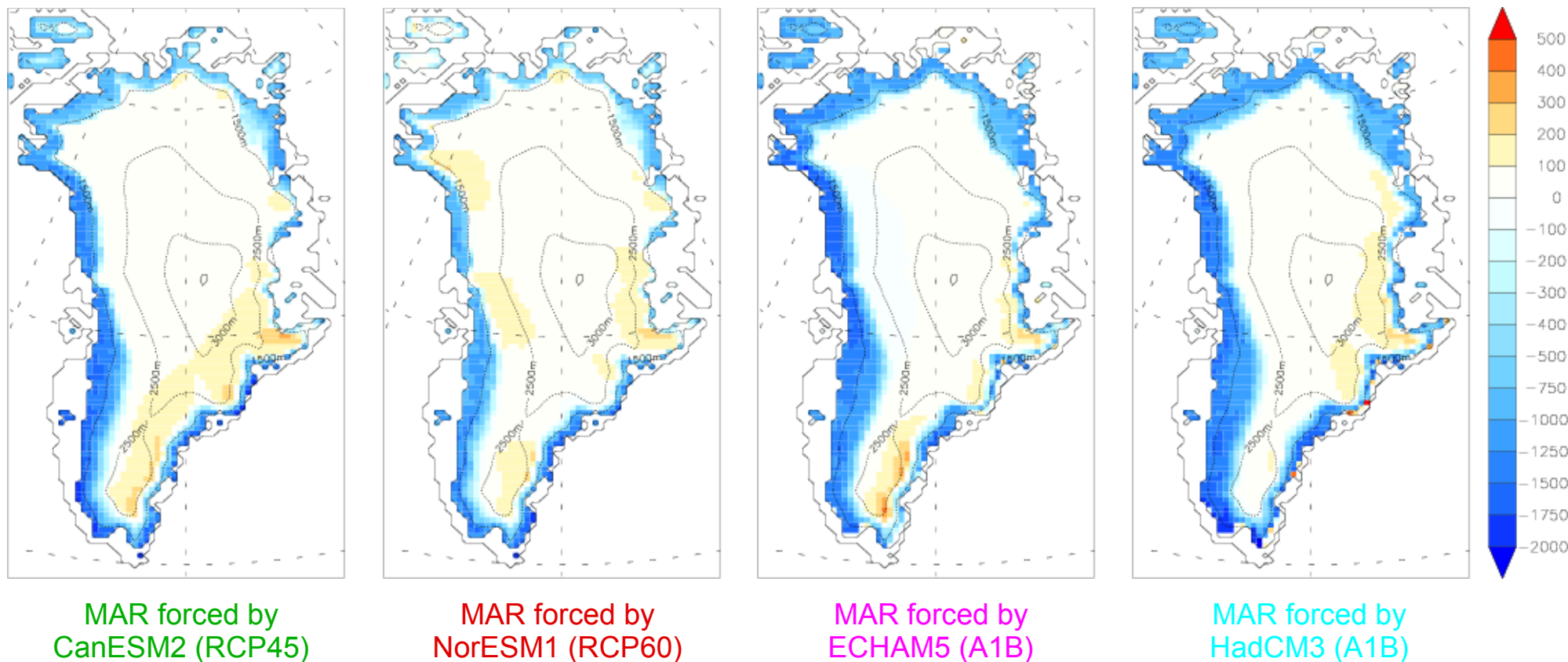


## 2. MAR based future climate (3/5)



Reference: 1980-1999

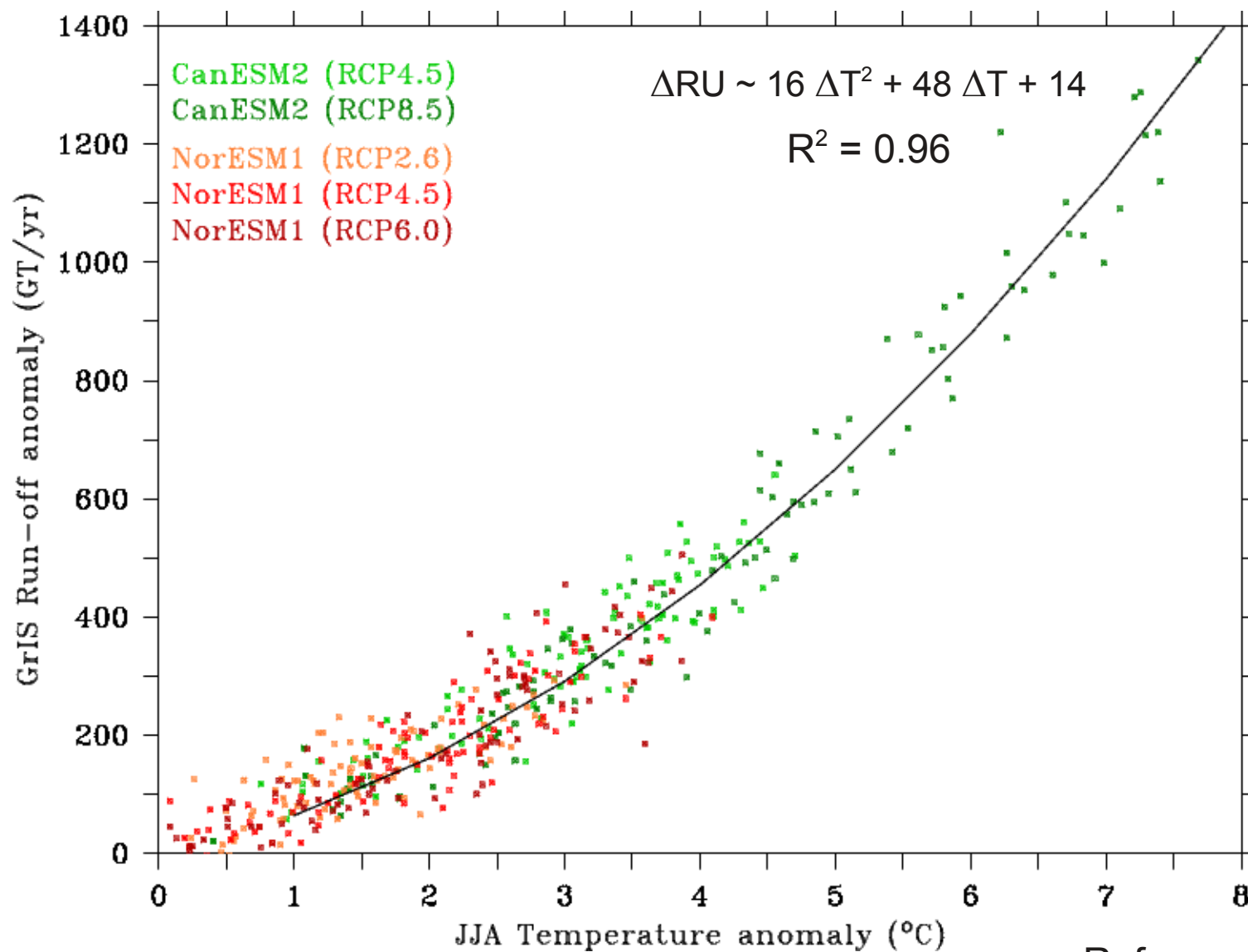
## 2. MAR based future climate (4/5)



2080-2099 SMB (GT/yr) anomaly in respect to 1980-1999.

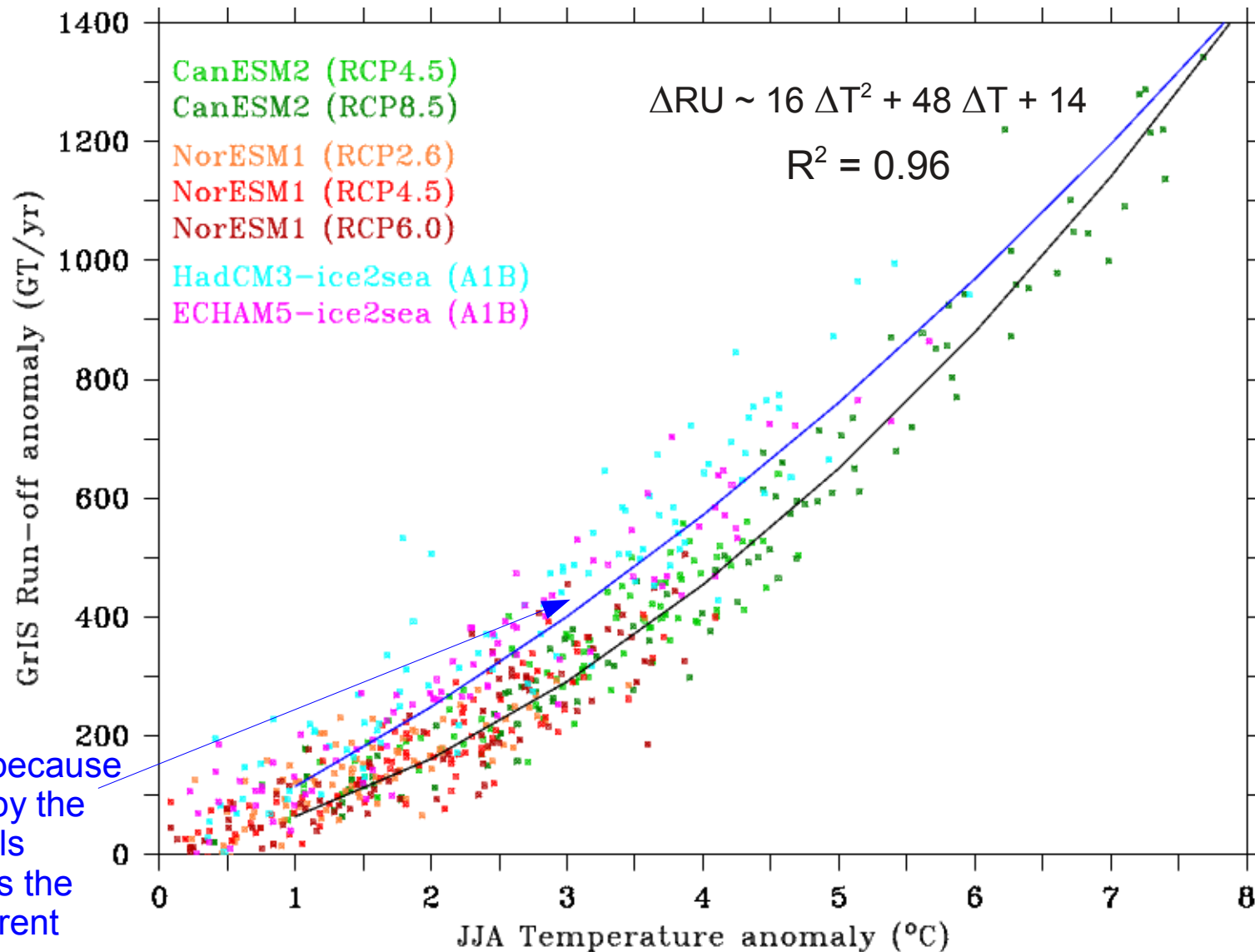


## 2. MAR based future climate (5/5)



Reference: 1980-1999

## 2. MAR based future climate (5/5)

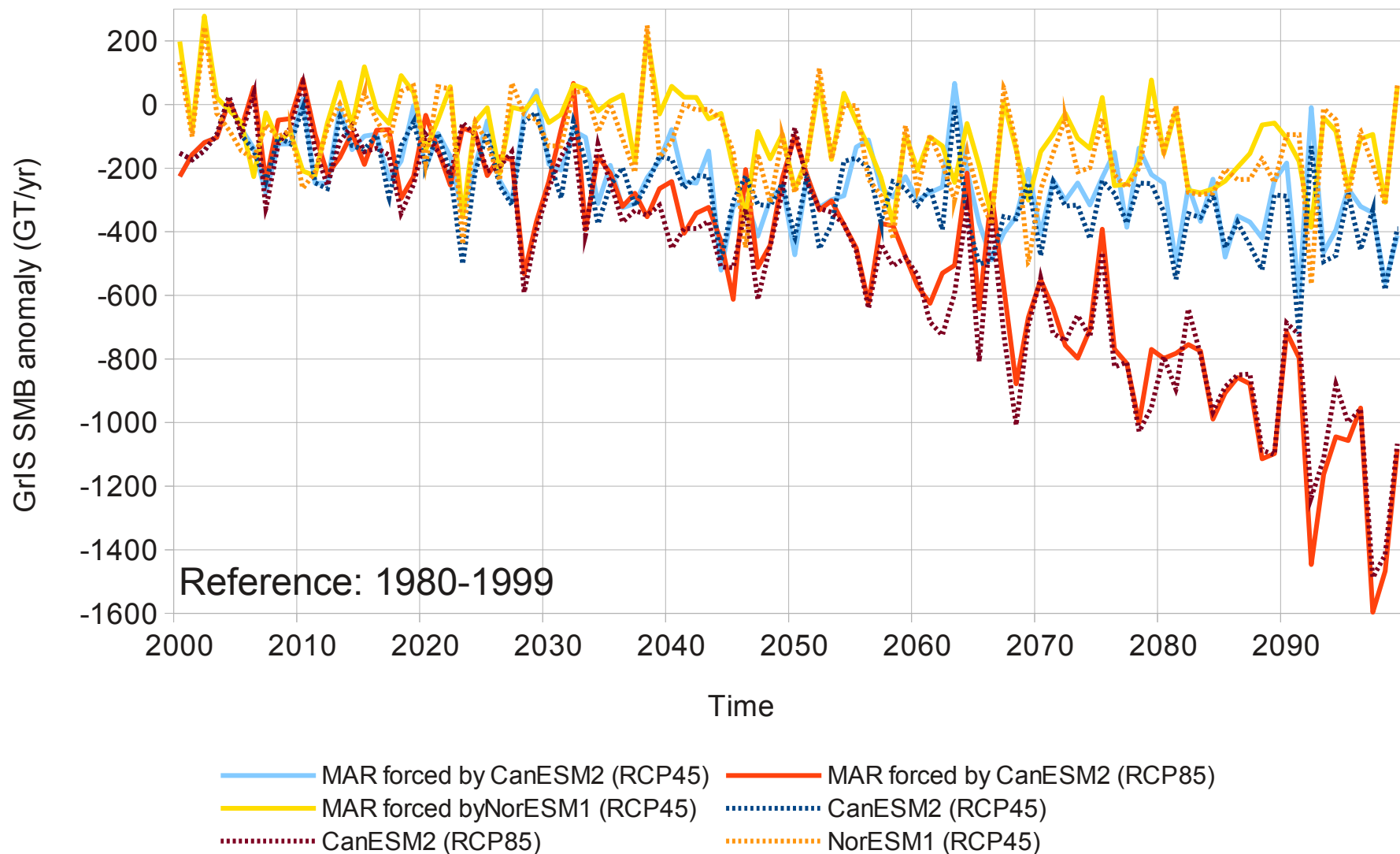


Higher here because  
MAR forced by the  
CMIP3 models  
overestimates the  
melt over current  
climate.

Reference: 1980-1999



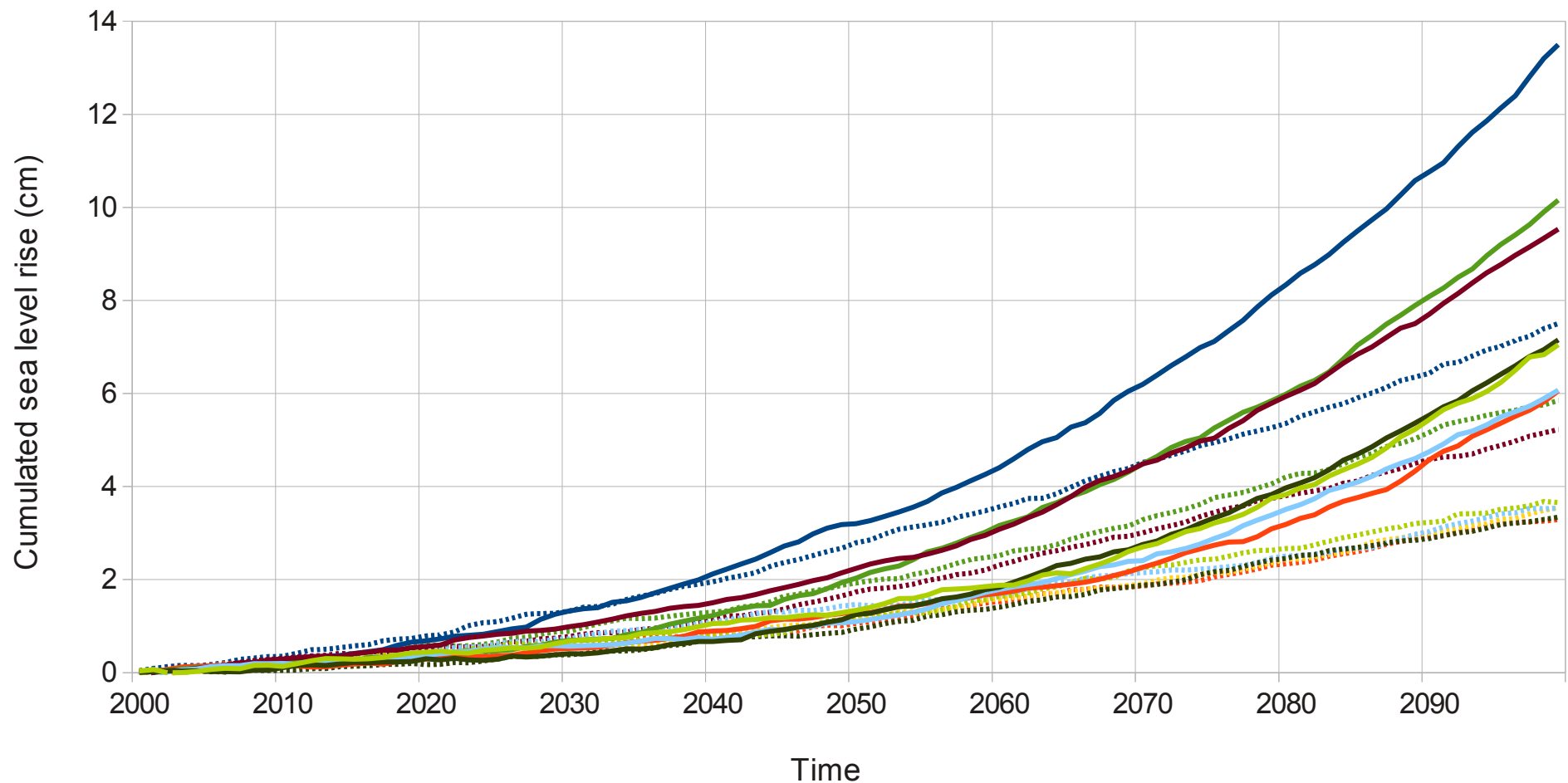
# 3. GCM's based future climate (1/2)



$$\Delta \text{SMB}_{\text{CMIP5}} \sim \Delta \text{SF}_{\text{CMIP5}} - \Delta \text{RU}(\Delta T_{\text{CMIP5}})$$

where  $\Delta \text{SF}$  and  $\Delta T$  are taken in the area 60°N-80°N, 60°W-20°W covering the Greenland ice sheet.

# 3. GCM's based future climate (2/2)



- |                             |                             |                            |
|-----------------------------|-----------------------------|----------------------------|
| ..... CanESM2 (RCP45)       | ..... CSIRO-Mk3-6-0 (RCP45) | ..... HadGEM2-ES (RCP45)   |
| ..... IPSL-CM5A-LR (RCP45)  | ..... IPSL-CM5A-MR (RCP45)  | ..... MIROC5 (RCP45)       |
| ..... MPI-ESM-LR (RCP45)    | ..... NorESM1-M (RCP45)     | ..... CanESM2 (RCP85)      |
| ..... CSIRO-Mk3-6-0 (RCP85) | ..... IPSL-CM5A-LR (RCP85)  | ..... IPSL-CM5A-MR (RCP85) |
| ..... MIROC5 (RCP85)        | ..... MPI-ESM-LR (RCP85)    | ..... NorESM1-M (RCP85)    |



## Conclusions:

- Large range in the SLR future projections.
- Importance of successfully simulating the current climate.

## Next steps:

- MAR is now running forced by NorESM1 (RCP8.5).
- Testing MIROC5 as MAR forcing.
- Confirming  $\Delta RU = f(\Delta T)$  with other RCMs from ice2sea and with the MIROC5 forced MAR simulations.
- Applying  $\Delta SMB$  to all CMIP5 models for having an ensemble mean.
- Using the MAR future projections the nearest of the ensemble mean as forcing for ice sheet models.

Thanks !

